Carbon energy window ⇔ A_N uncert.

Pol. mtg. 19.05.11

- We measure polarization (asymmetry) in some k.e. window:

  $$E_{min} < T < E_{min} + E_{width}$$

- Window has effective analyzing power, event-weighted $A_N(T)$:

  $$A_{N\text{-eff}} = \int dT\, A_N(T)\, dN/dT \,/\, \int dT\, dN/dT$$

  $A_N(T)$ = analyzing power @ T

  dN/dT = carbon T distribution

  $\int$'s over $E_{min} < T < E_{min} + E_{width}$

- Statistical uncert. on $P = \epsilon / A_{N\text{-eff}}$: $1/(A_{N\text{-eff}}\sqrt{N})$

  N = total # events = $\int dT\, dN/dT$

- Systematic uncert. on $A_{N\text{-eff}}$:

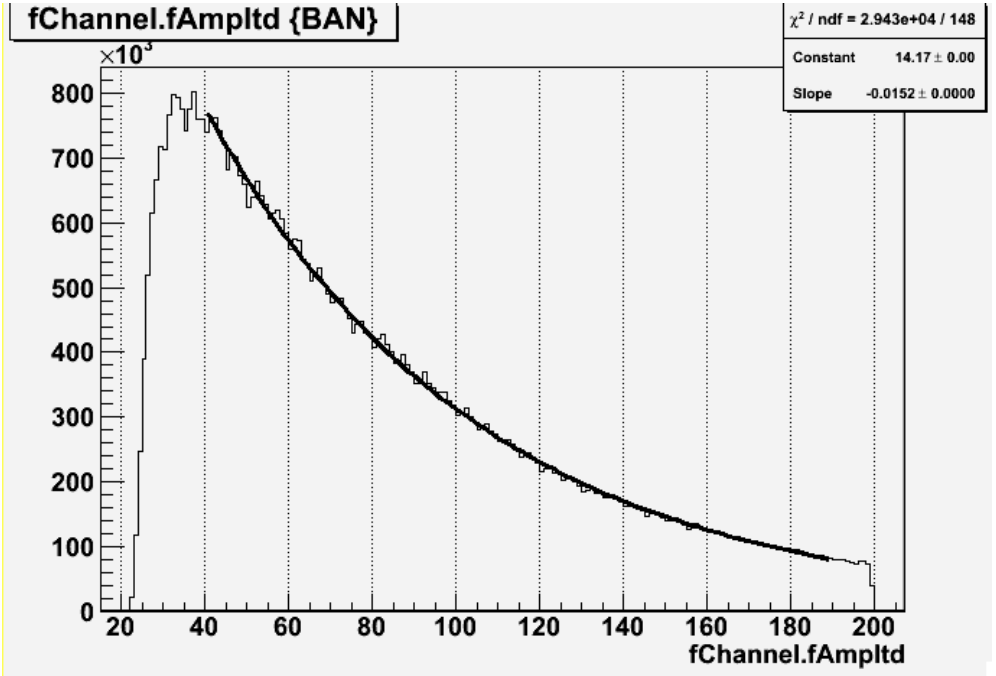
  run-to-run variations of window (E_{min},E_{width})

- Can: optimize window, determine uncertainties

- No final #'s here; just qualitative discussion

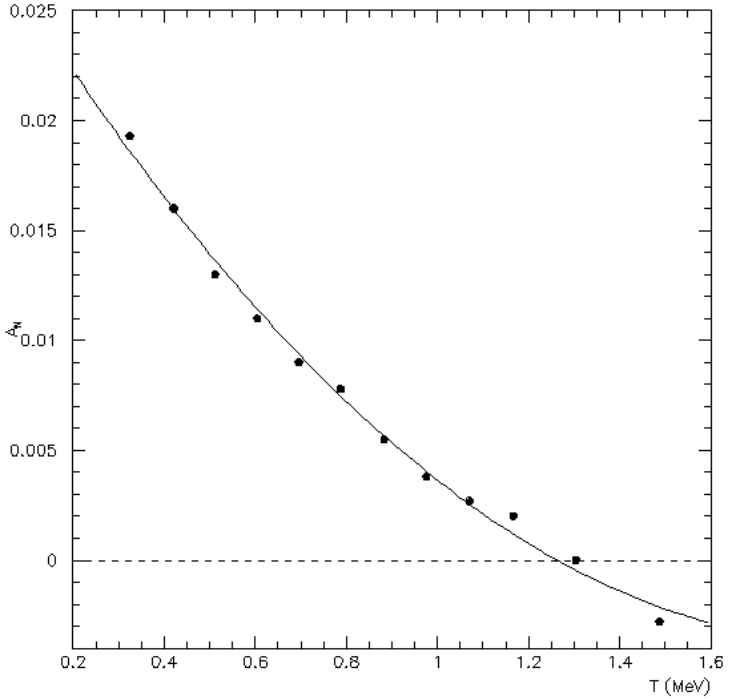
$A_{N\text{-eff}}$ calculation

dN/dT (from data):



- Fit dN/dT ∝ exp(-BT); B=2.2MeV^{-1}

$A_N(T)$ (from Sasha, Run??):

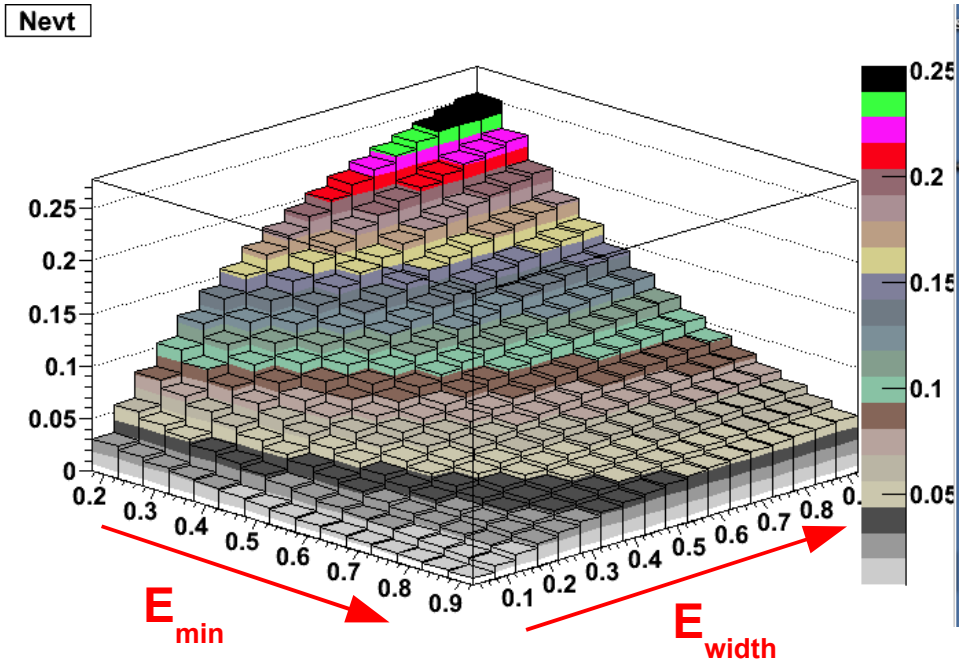


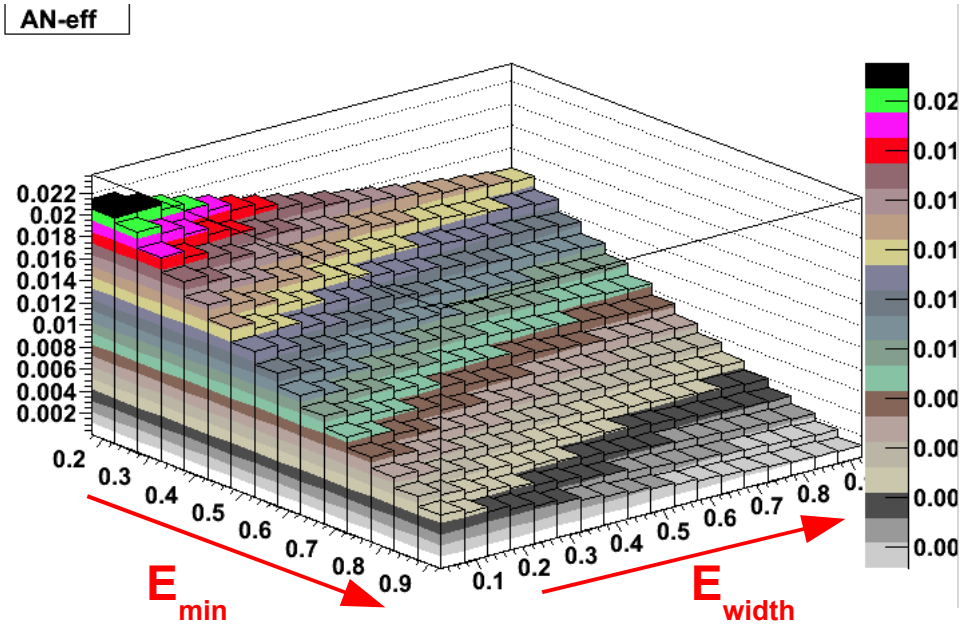
- Fit 2nd order poly. in T

- Evaluate $A_{N\text{-eff}}$ for various (E_{min},E_{width})
- Determine stat. uncert. $1/(A_{N\text{-eff}}\sqrt{N})$
- Determine sensitivity to variations (E_{min},E_{width})

N_{evt} & $A_{N\text{-}eff}$

- As functions of (E_{min},E_{width}):

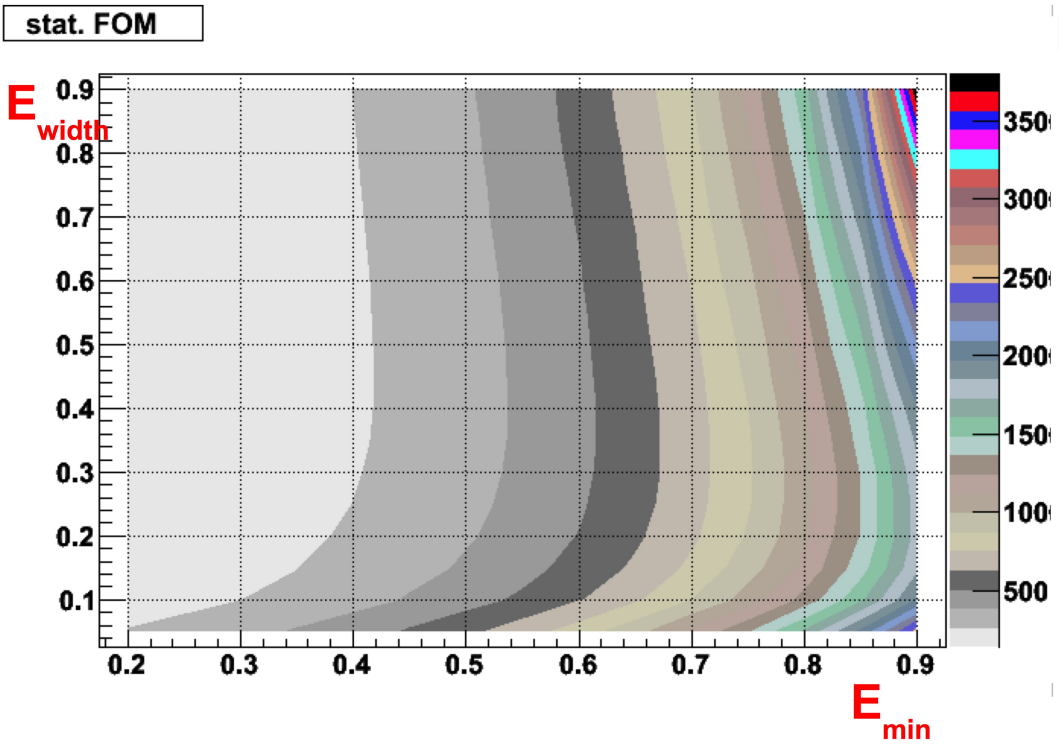


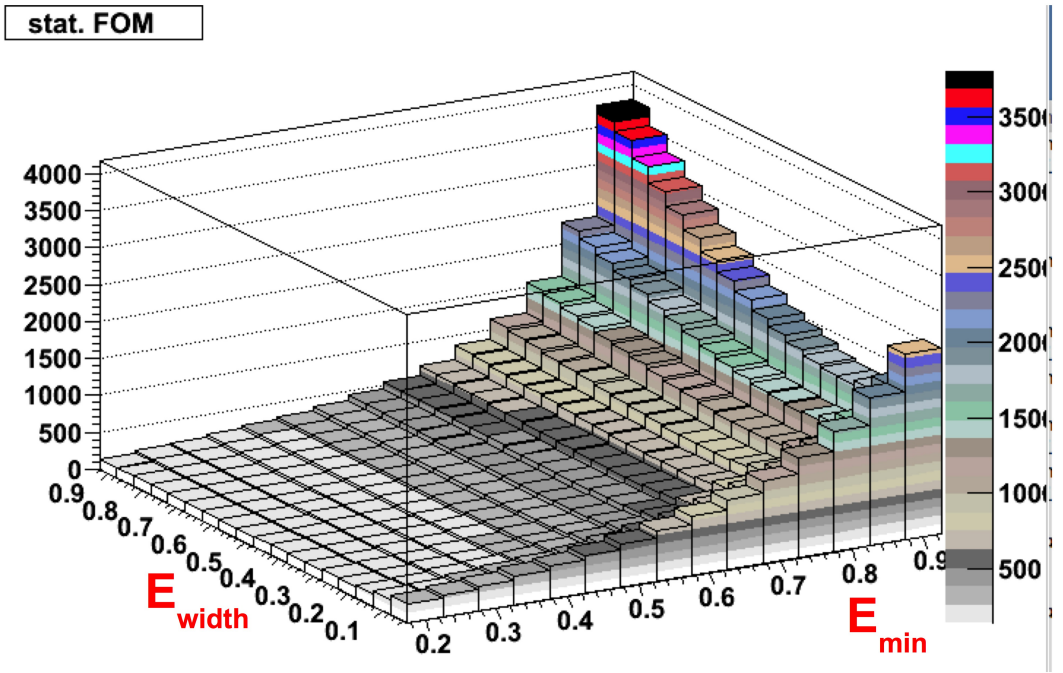


- $A_{N\text{-}eff}$ largest at small E_{min}: dN/dT, A_N(T) largest small T
- $A_{N\text{-}eff}$ largest at small E_{width}: diluted by smaller A_N(T) at growing T

$P=\epsilon/A_{N\text{-eff}}$ stat. uncert.

$\propto 1/(A_{N\text{-eff}}\sqrt{N})$; absolute value here arbitrary





Stat. uncert.:

- Smaller with decreasing E_{min}
- Broad minimum above some low E_{width} (increase statistics, N_{evt})

$A_{N\text{-}eff}$ sys. uncert.

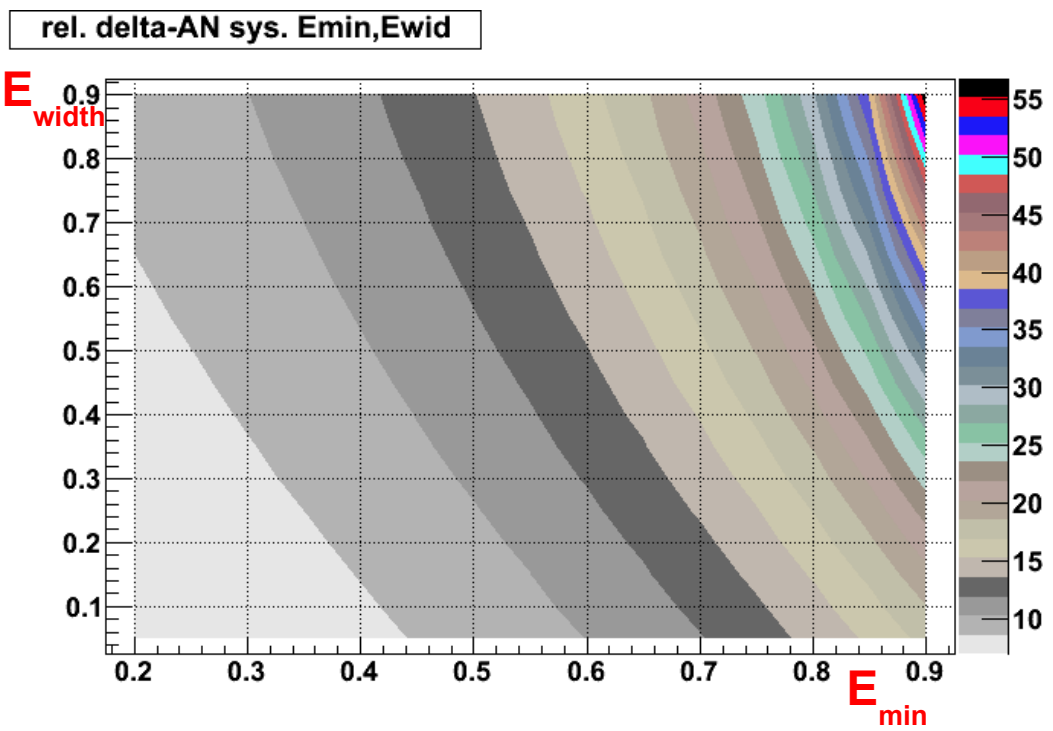
First: why characterize E-window by (E_{min},E_{width}) ?

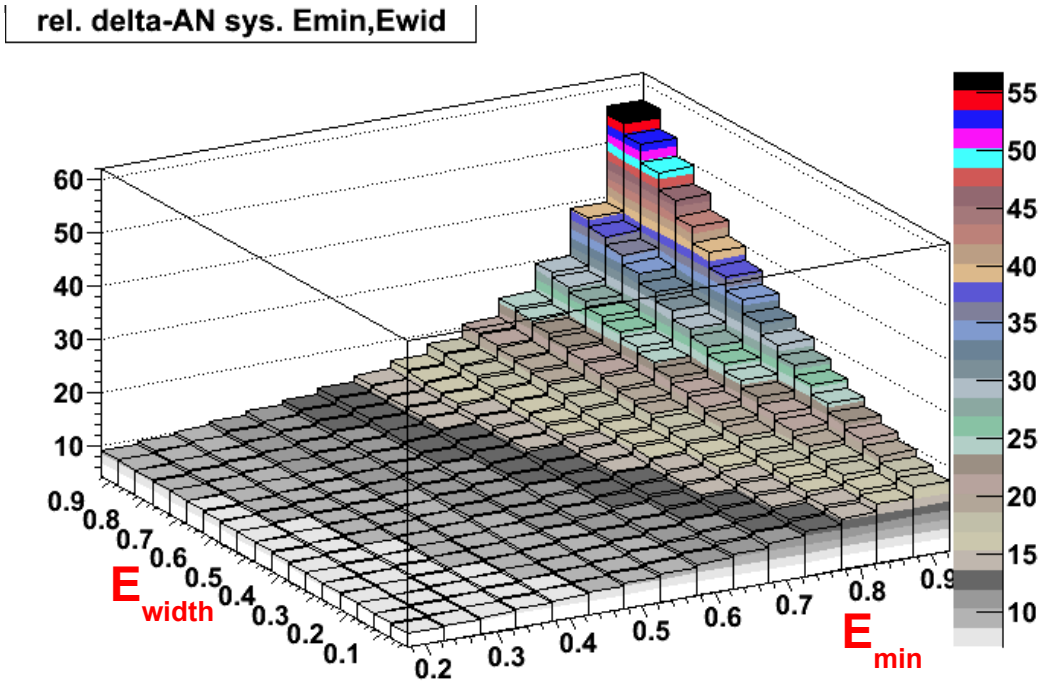
- Energy scale uncertainty: e.g. scale from α calib., shift from dead layer
  - lower/upper edges of E-window move together
  - estimate effect by varying E_{min}, hold E_{width} fixed
- Relative energy uncertainty:
  - on difference between two energies, e.g. low/up edges E-window
  - estimate effect by varying E_{width}, hold E_{min} fixed
- Usually $\sigma(E_{scale}) > \sigma(E_{relative})$

This quick study:

- Make variations of (E_{min},E_{width}), look at relative variation $\delta A_{N\text{-}eff}/A_{N\text{-}eff}$
- Take $\sigma(E_{scale}) = \sigma(E_{relative})$ = 50 keV, ~size of dead layer correction
  hopefully a big overestimate
- Add (E_{min},E_{width}) variations in quadrature
  each separately have same dependences as sum

$A_{N\text{-}eff}$ sys. uncert.



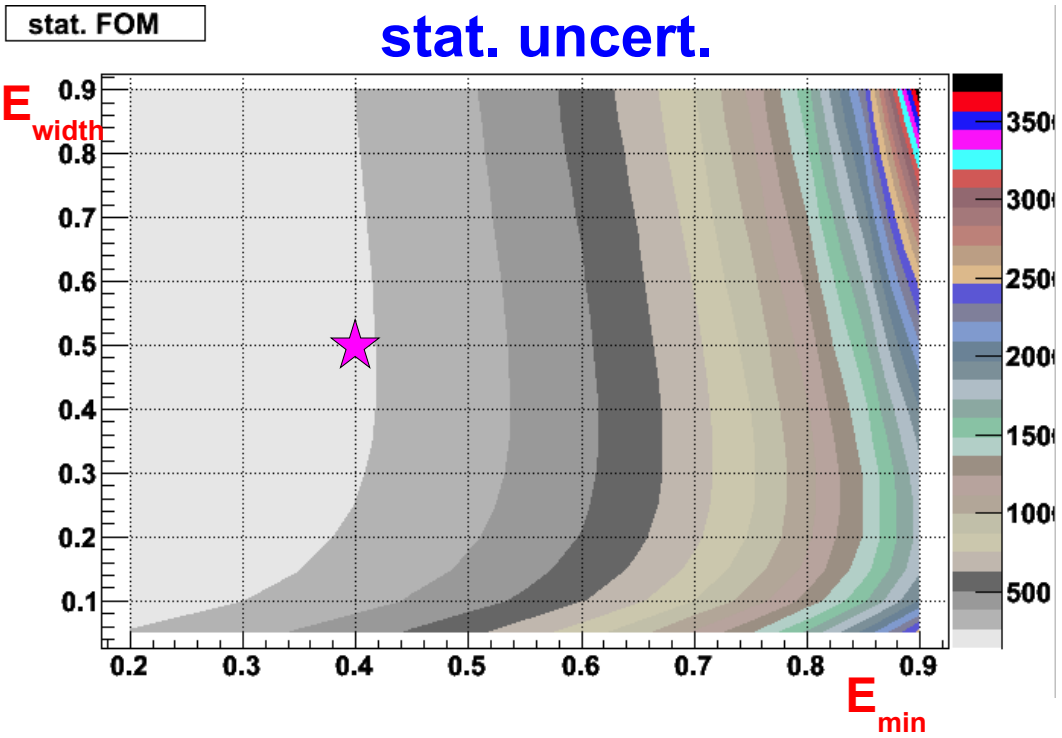


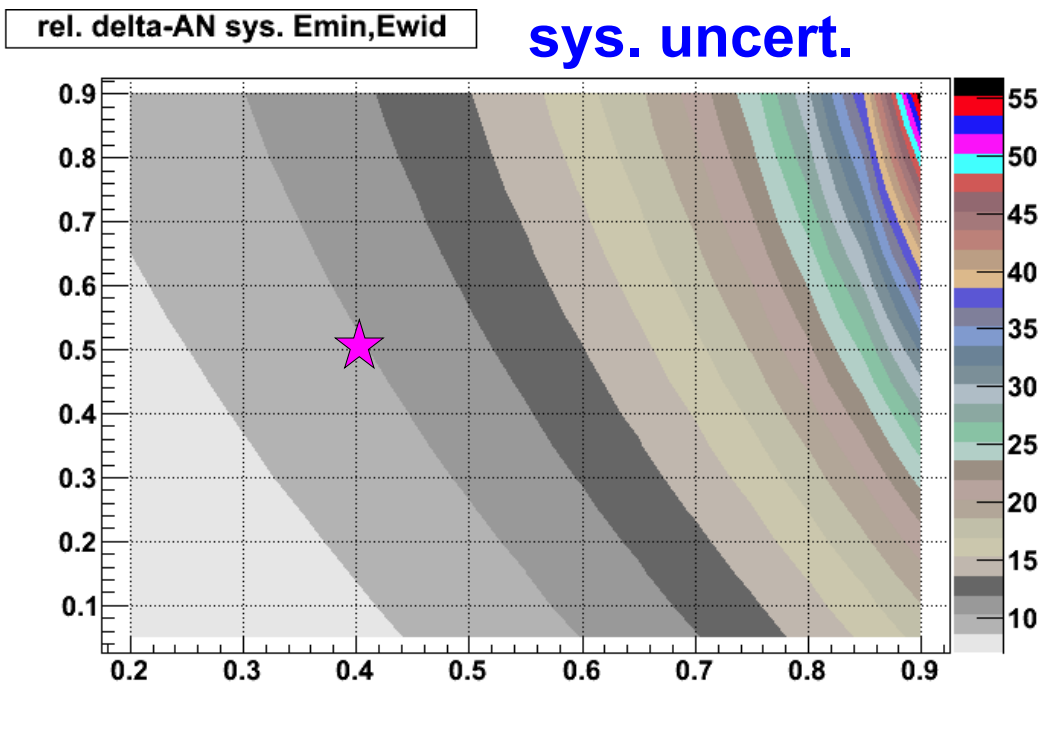
Sys. uncert.:

- Smaller with decreasing E_{min}
- Smaller with decreasing E_{width}

$A_{N\text{-}eff}$ window

- Presently use window 0.4-0.9 MeV★:





- Present window is sensible in terms of uncertainties
- With numbers for N_{evt}, $\sigma(E_{scale})$, $\sigma(E_{relative})$ can evaluate uncert.

<u>Improvement?</u>

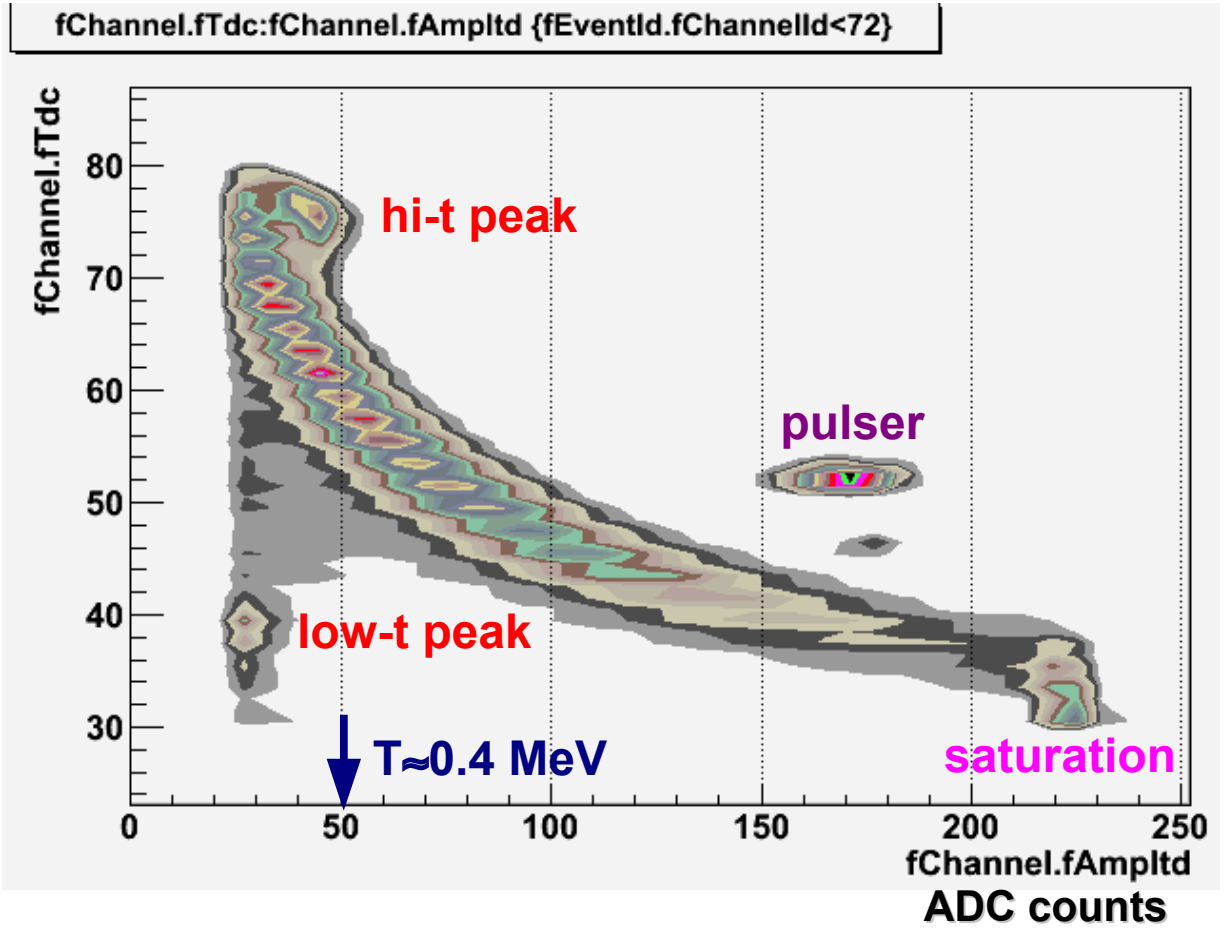
- Could improve (somewhat) by lowering E_{min}
- But: low energy features on (Energy,Time) plot??? ↘

Low Energy on (Time,Amp) plot

- Banana + additional low energy features:

run 154732.306
@ 24 GeV

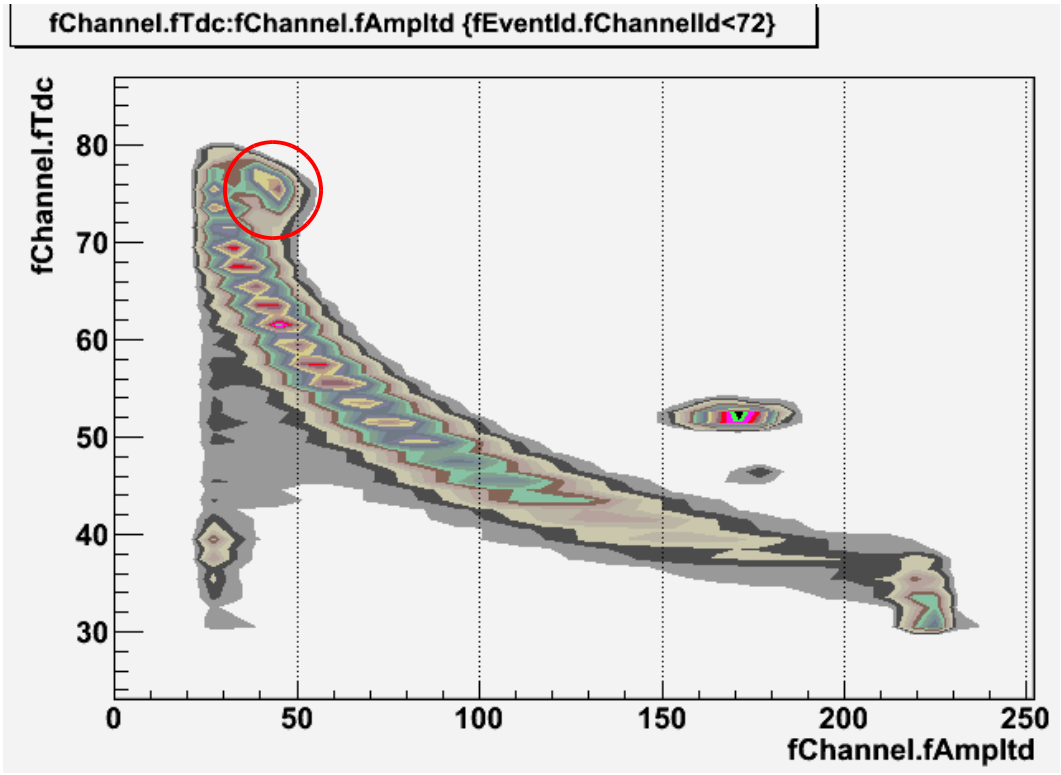
TDC units
= 1.2 nS



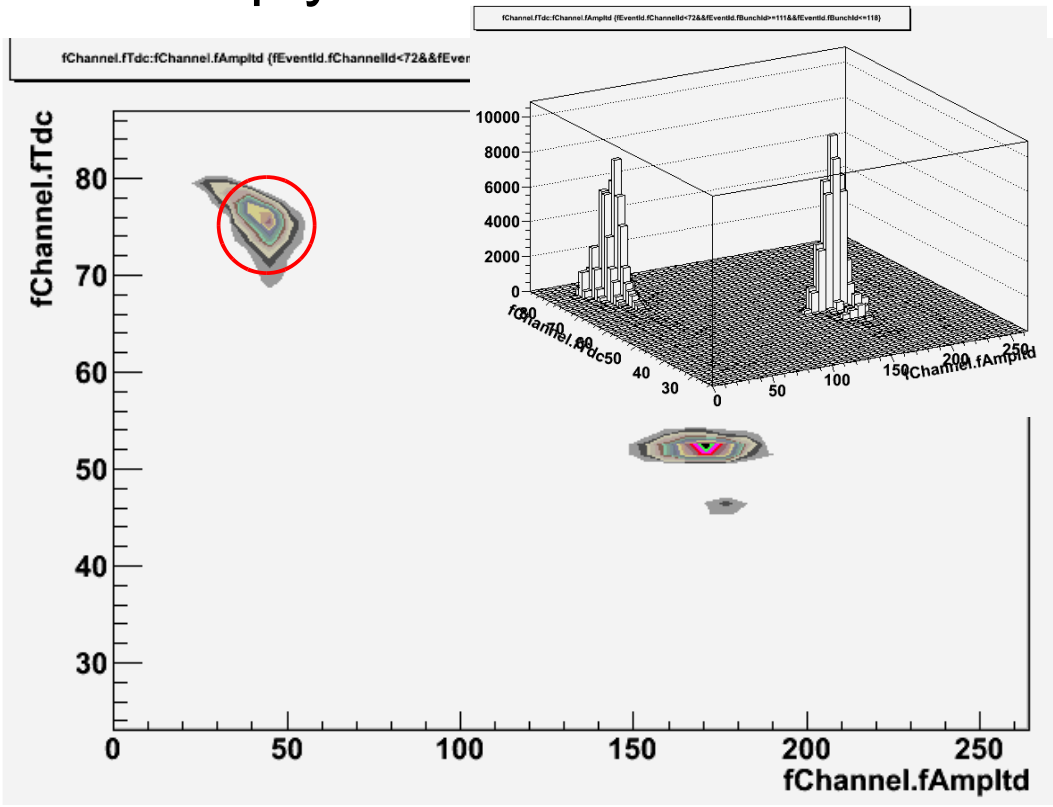
- What are they?
- Can we work around, use banana @ <0.4 MeV?

hi-t Low Energy peak

- All bunches #0-119:



- Empty bunches #111-118:

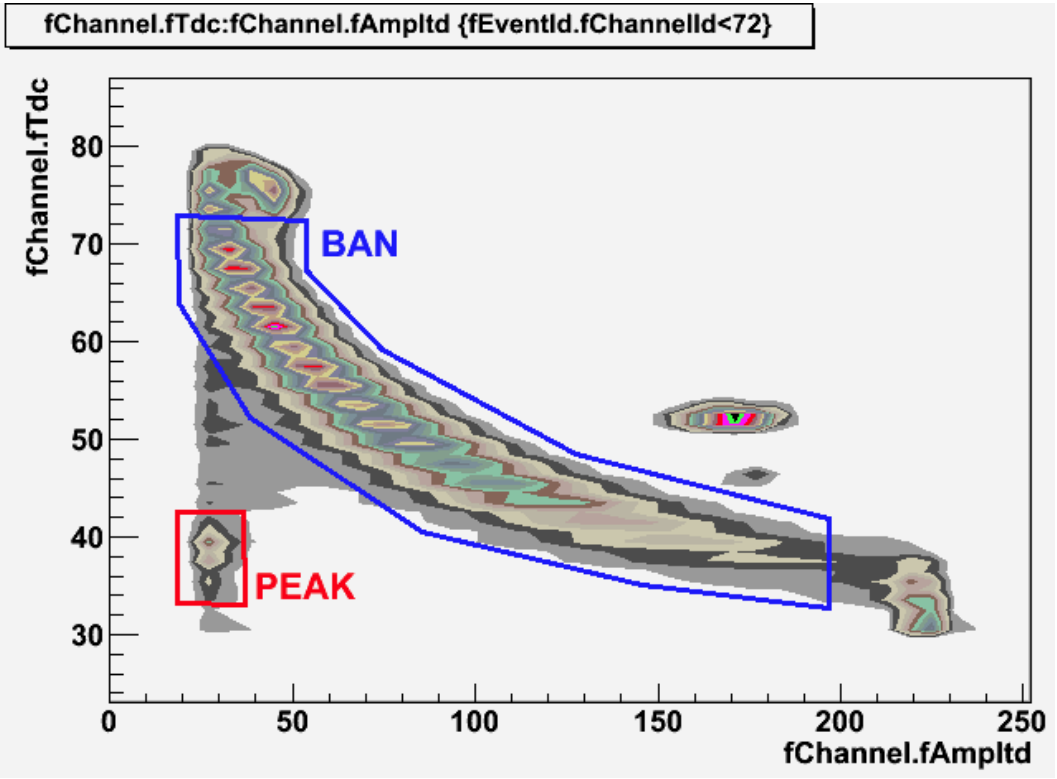


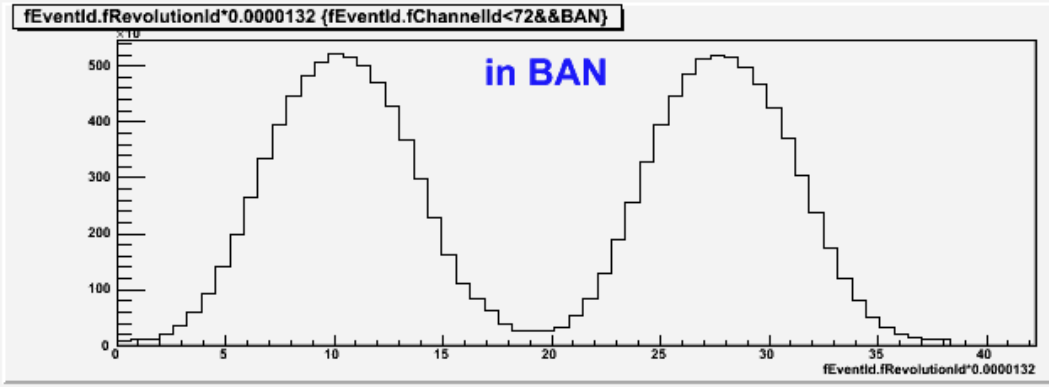
- The low-t low E peak is an 'echo' of the pulser, ~same rate outside time window @ 250 GeV; not seen in other polar. @ 24 GeV

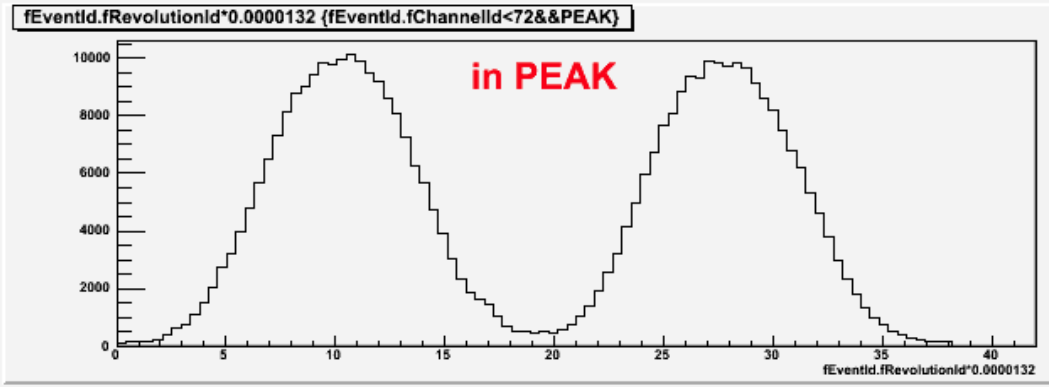
- Could easily do empty-bunch subtraction for distributions:
  (subt. dist.) = (dist. bunch# 0-110) – (111/8)×(dist. bunch# 111-118)
  (avoid last bunch #119, extra slide)

low-t Low Energy peak

- Rate vs. time in BAN, PEAK:





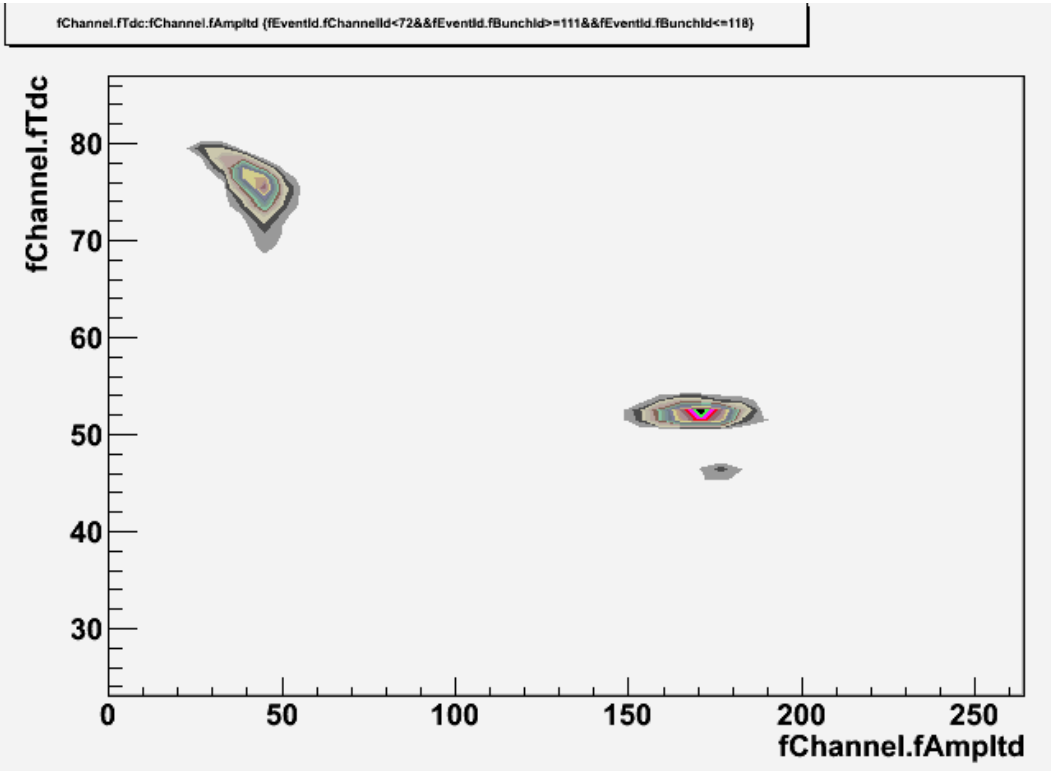


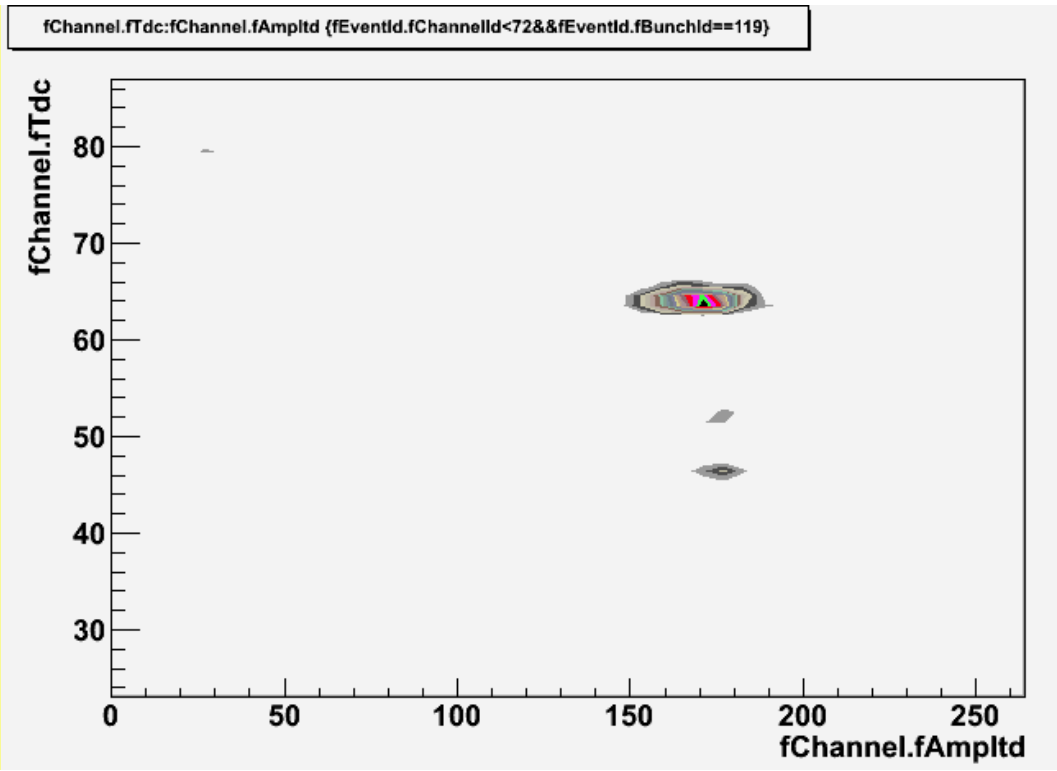
- The low-t Low-E peak is a pC scattering product
- With ~calibration, it has E≈0.23 MeV, TOF≈46 nS
- If E is kinetic energy, it has M≈2.7 GeV ???
- Shown here in Y2D @ 24 GeV; in all polarim., all E_p (I think)
- **What is it?**
- **Does is have an asymmetry?**

EXTRAS

last bunch #119

- pulser in empty bunches #111-118:
- pulser in empty bunche #119:

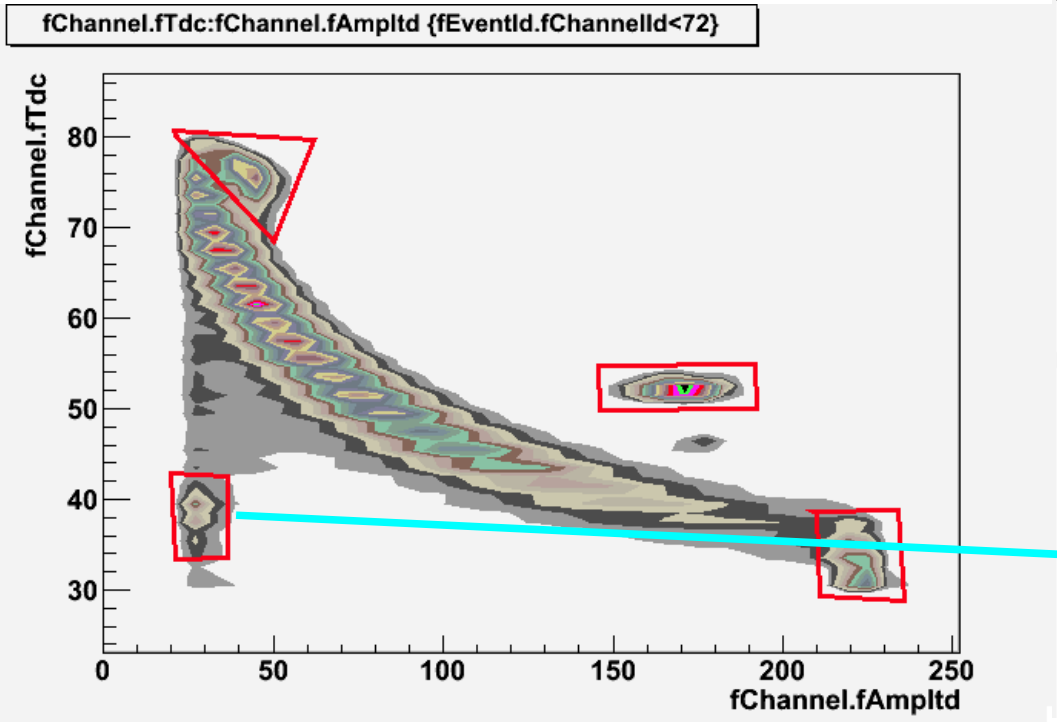


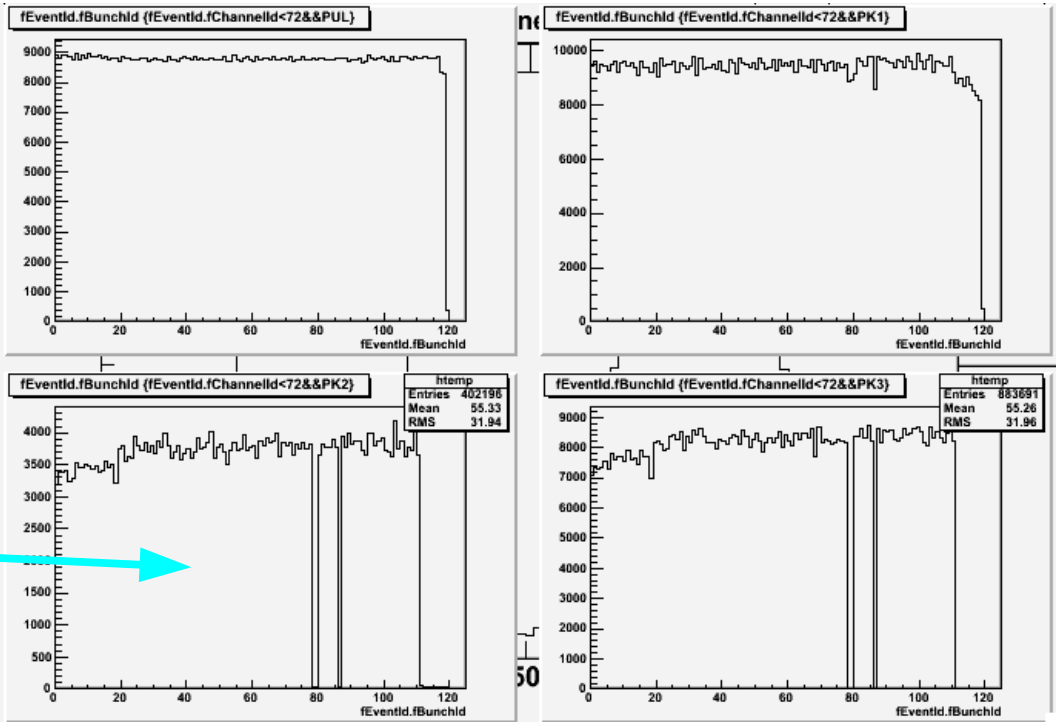


- Igor warned about problems with last bunch
- Here see time shifted ~+12 TDC units
- Pulser 'echo' shited above t-window

low-t Low Energy peak

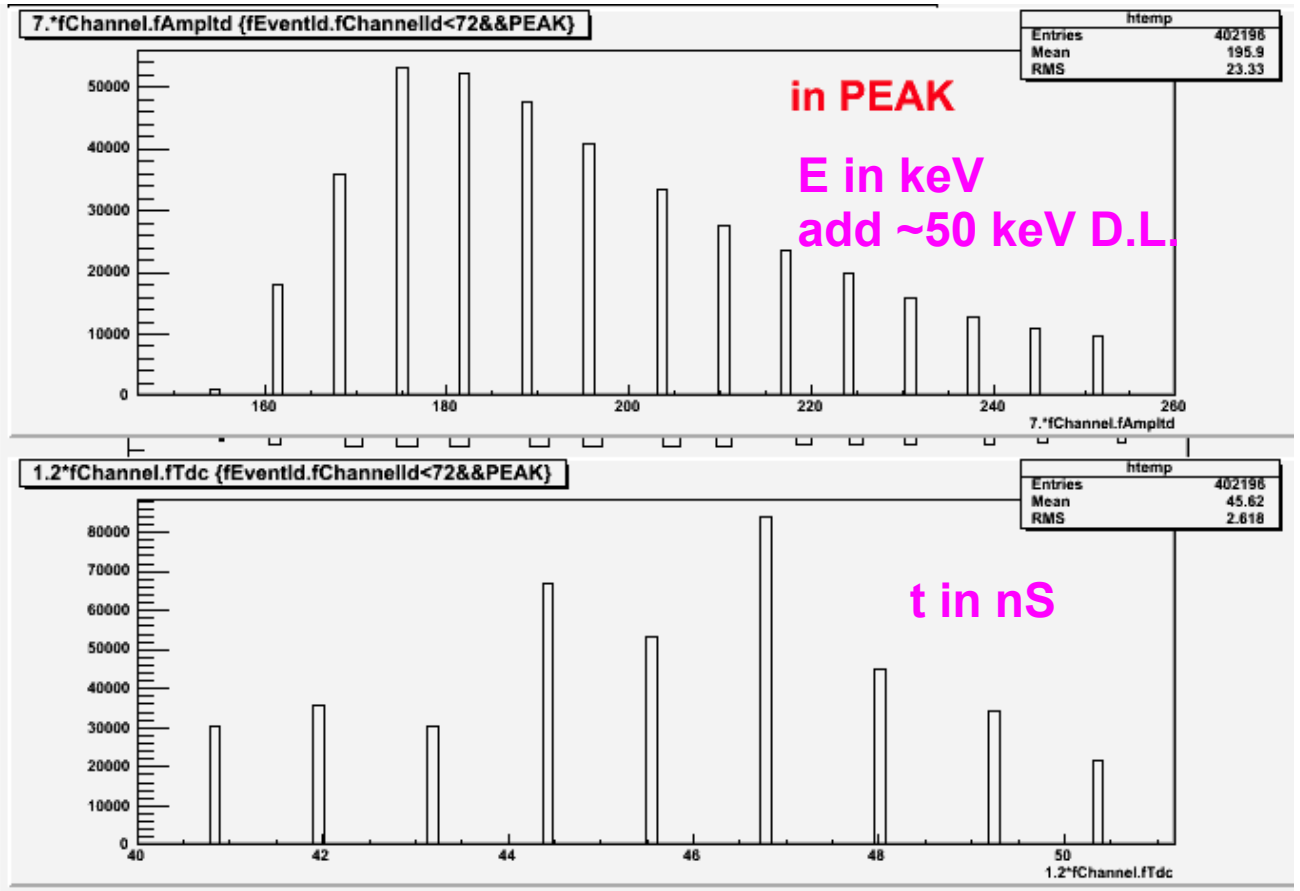
- Rate vs. bunch #





- The low-t Low-E peak is not in empty bunches

low-t Low Energy peak



- E ~ 0.23 MeV ; t ~ 46 nS